

06-08-00

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DOCKET NO. : THOM-0009

PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In Re Application of:

Hugh Frederick Collins

Serial No.: Not Assigned Yet

Group Art Unit: Not Assigned Yet

Filing Date: Herewith

Examiner: Not Assigned Yet

For: REJUVENATION AND/OR CLEANING OF CATALYSTS

EXPRESS MAIL LABEL NO: EL567666386US

DATE OF DEPOSIT: June 7, 2000

Box ☒ Patent Application
☐ Provisional ☐ Design

Assistant Commissioner for Patents
Washington DC 20231

Sir:

PATENT APPLICATION TRANSMITTAL LETTER

Transmitted herewith for filing, please find

☒ A Utility Patent Application under 37 C.F.R. 1.53(b).

It is a continuing application, as follows:

☐ continuation ☐ divisional ☐ continuation-in-part of prior application number
____/____.

☐ A Provisional Patent Application under 37 C.F.R. 1.53(c).

☐ A Design Patent Application (submitted in duplicate).

Including the following:

☐ Provisional Application Cover Sheet.

☒ New or Revised Specification, including pages 1 to 19 containing:

☒ Specification

☒ Claims

☐ Abstract

☐ Substitute Specification, including Claims and Abstract.

☐ The present application is a continuation application of Application No. _____ filed _____. The present application includes the Specification of the parent application which has been revised in accordance with the amendments filed in the parent application. Since none of those amendments incorporate new matter into the parent application, the present revised Specification also does not include new matter.

☐ The present application is a continuation application of Application No. _____ filed _____, which in turn is a continuation-in-part of Application No. _____ filed _____. The present application includes the Specification of the parent application which has been revised in accordance with the amendments filed in the parent application. Although the amendments in the parent C-I-P application may have incorporated new matter, since those are the only revisions included in the present application, the present application includes no new matter in relation to the parent application.

☐ A copy of earlier application Serial No. _____ Filed _____, including Specification, Claims and Abstract (pages 1 - @@), to which no new matter has been added TOGETHER WITH a copy of the executed oath or declaration for such earlier application and all drawings and appendices. Such earlier application is hereby incorporated into the present application by reference.

☐ Please enter the following amendment to the Specification under the Cross-Reference to Related Applications section (or create such a section) : "This Application:

☐ is a continuation of ☐ is a divisional of ☐ claims benefit of U.S. provisional Application Serial No. _____ filed _____

- ☐ Signed Statement attached deleting inventor(s) named in the prior application.
- ☒ A Preliminary Amendment.
- ☐ _____ Sheets of ☐ Formal ☐ Informal Drawings.
- ☐ Petition to Accept Photographic Drawings.
- ☐ Petition Fee
- ☒ An ☐ Executed ☒ Unexecuted Declaration or Oath and Power of Attorney.
- ☐ An Associate Power of Attorney.
- ☐ An ☐ Executed ☐ Copy of Executed Assignment of the Invention to _____
_____.
- ☐ A Recordation Form Cover Sheet.
- ☐ Recordation Fee - \$40.00.
- ☐ The prior application is assigned of record to _____
- ☐ Priority is claimed under 35 U.S.C. § 119 of Patent Application No. _____
filed _____ in _____ (country).
- ☐ A Certified Copy of each of the above applications for which priority is
claimed:
- ☐ is enclosed.
- ☐ has been filed in prior application Serial No. _____ filed _____.
- ☐ An ☐ Executed or ☐ Copy of Executed Earlier Statement Claiming Small Entity
Status under 37 C.F.R. 1.9 and 1.27
- ☐ is enclosed.
- ☐ has been filed in prior application Serial No. _____ filed _____,
said status is still proper and desired in present case.
- ☐ Diskette Containing DNA/Amino Acid Sequence Information.
- ☐ Statement to Support Submission of DNA/Amino Acid Sequence Information.

- ☐ The computer readable form in this application _____, is identical with that filed in Application Serial Number _____, filed _____. In accordance with 37 CFR 1.821(e), please use the ☐ first-filed, ☐ last-filed or ☐ only computer readable form filed in that application as the computer readable form for the instant application. It is understood that the Patent and Trademark Office will make the necessary change in application number and filing date for the computer readable form that will be used for the instant application. A paper copy of the Sequence Listing is ☐ included in the originally-filed specification of the instant application, ☐ included in a separately filed preliminary amendment for incorporation into the specification.
- ☐ Information Disclosure Statement.
- ☐ Attached Form 1449.
- ☐ Copies of each of the references listed on the attached Form PTO-1449 are enclosed herewith.
- ☐ A copy of Petition for Extension of Time as filed in the prior case.
- ☐ Appended Material as follows: _____
- ☒ Return Receipt Postcard (should be specifically itemized).
- ☐ Other as follows: _____



06/07/00

DOCKET NO. : THOM-0009

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PATENT

FEE CALCULATION:

- ☐ Cancel in this application original claims _____ of the prior application before calculating the filing fee. (At least one original independent claim must be retained for filing purposes.)

				SMALL ENTITY		NOT SMALL ENTITY					
				RATE	FEE	RATE	FEE				
PROVISIONAL APPLICATION				\$75.00	\$	\$150.00	\$				
DESIGN APPLICATION				\$155.00	\$	\$310.00	\$				
UTILITY APPLICATIONS BASE FEE				\$345.00	\$	\$690.00	\$690.00				
UTILITY APPLICATION; ALL CLAIMS CALCULATED AFTER ENTRY OF ALL AMENDMENTS											
		No. Filed	No. Extra								
	TOTAL CLAIMS	53 - 20 =	33					\$9 each	\$	\$18 each	\$594.00
	INDEP. CLAIMS	2 - 3 =	0					\$39 each	\$	\$78 each	\$
	FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM			\$130	\$	\$260	\$260.00				
ADDITIONAL FILING FEE					\$		\$				
TOTAL FILING FEE DUE					\$		\$1544.00				

- ☒ A Check is enclosed in the amount of \$1544.00
- ☒ The Commissioner is authorized to charge payment of the following fees and to refund any overpayment associated with this communication or during the pendency of this application to deposit account 23-3050. This sheet is provided in duplicate.
- ☐ The foregoing amount due.
- ☒ Any additional filing fees required, including fees for the presentation of extra claims under 37 C.F.R. 1.16.
- ☒ Any additional patent application processing fees under 37 C.F.R. 1.17 or 1.20(d).
- ☐ The issue fee set in 37 C.F.R. 1.18 at the mailing of the Notice of Allowance.
- ☒ The Commissioner is hereby requested to grant an extension of time for the appropriate length of time, should one be necessary, in connection with this filing or any future filing submitted to the U.S. Patent and Trademark Office in the above-identified application during the pendency of this application. The Commissioner is

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further authorized to charge any fees related to any such extension of time to deposit account 23-3050. This sheet is provided in duplicate.

SHOULD ANY DEFICIENCIES APPEAR with respect to this application, including deficiencies in payment of fees, missing parts of the application or otherwise, the United States Patent and Trademark Office is respectfully requested to promptly notify the undersigned.

Date:

Aug 7, 2000

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DOCKET NO.: THOM-0009

PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of :

Hugh Frederick Collins

Serial No.: Not Yet Assigned

Group Art Unit: Not Yet Assigned

Filed: June 5, 2000

Examiner: Not Yet Assigned

For: REJUVENATION AND/OR CLEANING OF CATALYSTS

EXPRESS MAIL LABEL NO: EL567666386US

DATE OF DEPOSIT: June 7, 2000

Assistant Commissioner for Patents
Washington, D.C. 20231

PRELIMINARY AMENDMENT

Applicant requests that the above-captioned application be amended, before examination and without prejudice, as follows:

In the Abstract:

Please add the following Abstract to the application:

-- ABSTRACT OF THE INVENTION

Compositions and methods are provided for cleaning and/or rejuvenating catalysts, including catalysts of the type used in vehicle catalytic converters. The compositions of the invention comprise a hydrocarbon source and an oxygen donor, which may be one and the same compound.

The composition may be combustible, and the composition may generate organic acid vapor upon combustion. The composition may also include a number of trace metals. Methods according to the invention include the steps of bringing the catalyst up to working temperature and passing the rejuvenating and/or cleansing composition or the combustion products of the rejuvenating and/or cleansing composition over the catalyst. --

In the Specification:

On page 14 at lines 27 through 33, please delete the References section.

In the Claims:

Please amend the claims as follows:

Each of claims 1 through 11, and 13 through 19, line 1, delete “and/or” and substitute -- or-- therefore.

Each of claims 2 through 11, and 13 through 17, line 1, delete “A rejuvenating” and substitute --The rejuvenating-- therefore.

Claim 5, line 3 delete “and/or” and substitute -- or-- therefore.

Claims 6, 7, 8, 9, 10, and 11 line 3, delete “include” and substitute -- comprises -- therefore.

Claim 6, line 4, delete “and/or” and substitute -- or-- therefore.

Claim 10, line 3, delete “and” and substitute -- or -- therefore.

Claim 11, line 3, delete “(kerosene) and/or ” and substitute --, kerosene, or --
therefore.

Delete claim 12 without prejudice.

Rewrite claim 13 as follows:

13. (Amended) A rejuvenation [and/] or cleaning composition as
claimed in claim 5 [any one of the preceding claims] comprising isopropyl alcohol, acetone, xylene
and paraffin.

Rewrite claim 16 as follows:

16. (Amended) A rejuvenating [and/] or cleaning composition as claimed
in any one of [the preceding] claims 1 through 11, 14 and 15, comprising one or more of trace elements
[selected from] Sr, Bi, Cd, Ba, Ni, Mn, Fe, Na, Zn, Al, Ca, Cu, Pb, Co, K, Cr, Mg, As, Sn, Sb, V, Ti,
Be, Si, P, W, and Mo.

Rewrite claims 18 and 19 as follows:

18. (Amended) A method for rejuvenating or cleaning a catalyst in a
vehicle without removal of the catalyst from the vehicle comprising contacting the catalyst with the
composition of claim 1.

19. (Amended) A method of rejuvenating [and/] or cleaning a catalyst
in a vehicle catalytic converter [, in situ, in a vehicle i.e.] without removal of the catalyst from the
vehicle, said method comprising:

(I) bringing the catalytic converter up to working temperature; and then

(ii) passing [a rejuvenating and/or cleaning] a composition [as defined in claim 1] comprising at least one hydrocarbon source and at least one oxygen donor into [an] the engine of the vehicle [whilst] while running the engine at idle.

Claim 20, line 2 delete “rejuvenation and/or cleaning”.

Claim 21, line 7 - 8, delete “a rejuvenating and/or cleaning” and substitute -- the --
therefore.

Claim 21, line 9, delete “cleaning”.

Claim 22, lines 1 and 6, delete “and/”.

Delete claim 27 without prejudice.

Claim 29, line 2, delete “and/”.

REMARKS

Claims 1-29 are pending in the application. Claims 12 and 27 has been canceled without prejudice. Claims 1-11, 13-22 and 29 have been amended.

Amendments have been made to conform the application to United States patent practice. These amendments are purely formal, and neither add new matter nor change the scope of the claims as originally filed.

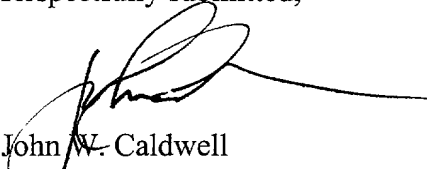
An Abstract of the Invention has been added. Claims have been amended into more standard U.S. form. The “References” section on page 14 has been deleted as informal. The references cited therein will be resubmitted in an information disclosure statement.

DOCKET NO.: THOM-0009

PATENT

Early and favorable consideration of the present application is requested respectfully.

Respectfully submitted,



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REJUVENATION AND/OR CLEANING OF CATALYSTS

BACKGROUND OF THE INVENTION

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1. Field of the Invention

The present invention relates to a rejuvenating and/or cleaning agent, particularly to a rejuvenating and/or cleaning agent for a catalyst of the type used in a vehicle catalytic converter, and to a method of
10 rejuvenating and/or cleaning the catalyst of a catalytic converter.

2. Brief Description of the Prior Art

15 Catalytic converters are now fitted to most internal combustion engine vehicles, in order to reduce the levels of undesirable components in exhaust emissions. In particular, exhaust emissions of carbon monoxide (CO), unburnt fuel hydrocarbon (HC) and nitrogen oxides (NO_x) are
20 regulated by law.

A catalytic converter usually comprises a noble metal catalyst, for example of platinum, palladium and/or rhodium, which converts undesirable unburnt hydrocarbons (HC) and carbon monoxide (CO) to carbon dioxide and water,
25 and nitrogen oxides (NO_x) to nitrogen and water. Typically, a catalytic converter consists of a cordierite ceramic monolith extruded to form a honeycomb-like structure of cells having a large surface area. The cell walls are coated with the metal catalyst, such that the
30 engine exhaust gases contact the catalyst surface prior to their emission into the atmosphere. Alternatively, the noble metal catalyst may be dispersed on a high surface area carrier in the form of alumina pellets.

A major problem with catalytic converters is that the

catalyst is easily poisoned and/or rendered less effective, for example by a build up of carbonaceous deposits, or by the accumulation of certain elements such as lead or phosphorus on the surface of the catalyst.

5 A number of processes have been employed for restoring the activity of the catalyst. Most, however, require the catalyst to be removed from the vehicle. One such method is described in European Patent Application EP 0178792 A, which discloses a method of regenerating a
10 phosphorus-poisoned exhaust catalyst by washing or soaking the catalyst in an acid solution and then heating the wetted catalyst in air.

There have also been attempts to overcome the problem of catalyst poisoning without removing the catalyst from
15 the vehicle. For example, European Patent Application EP 0070619 A describes a method of regenerating a catalyzed particulate filter by occasionally supplying an amount of unburnt fuel to the filter in order to ignite particulates deposited in the filter. PCT Application WO 97/41336 and
20 British Application GB 2328626 describe an apparatus and a method for regenerating a diesel engine NO_x catalyst which has been contaminated with SO_x, by adding a predetermined quantity of a reductant diesel fuel to the exhaust pipe via a special nozzle.

25 US Patent 5,316,558 to Gonzalez discloses a petroleum-derived fuel composition of improved efficiency which reduces the tendency of the fuel to create deposits, thus reducing exhaust emissions. There is no suggestion, however, that the disclosed compositions might serve to
30 regenerate a catalyst which has already been poisoned or affected by contaminants.

SUMMARY OF THE INVENTION

It is an object of the present invention to address at least some of the problems of catalyst deactivation by providing an improved composition for cleaning and/or rejuvenating a catalyst of the type found in a catalytic converter without having to remove the catalyst from the vehicle.

It is a further object of the present invention to provide an improved method of cleaning and/or rejuvenating a catalyst of the type found in a catalytic converter without having to remove the catalyst from the vehicle.

According to the present invention, the above-mentioned objects are achieved by passing a cleaning composition in situ into the vehicle engine whilst running the engine, the catalytic converter having first been brought up to working temperature.

According to a first aspect of the invention, there is provided a rejuvenating and/or cleaning composition for a catalyst of a vehicle catalytic converter, comprising at least one hydrocarbon source and at least one oxygen donor.

In some cases the oxygen donor or one of the oxygen donors and the hydrocarbon source or one of the hydrocarbon sources can be one and the same compound.

Preferably the composition is combustible. Preferably, the composition generates an organic acid vapour on combustion. More preferably, the organic acid vapour includes a carboxylic acid vapour.

Preferred compositions include one or more organic solvents as hydrocarbon source and/or oxygen donor. Examples of preferred organic solvents include: aliphatic alcohols, e.g. isopropyl alcohol; ketones, e.g. acetone; aromatic hydrocarbons, e.g. xylene; and aliphatic hydrocarbons, e.g. alkanes, paraffin (kerosene) and lamp oil. Clearly not all of the compounds are oxygen donors and the composition should include at least one oxygen

donor.

More preferably, the composition comprises one or more organic solvents selected from: isopropyl alcohol, acetone, xylene and paraffin. The first two of these components are both oxygen donors and hydrocarbons. Preferably the composition comprises all four of these ingredients.

Preferably the components of this mixture are present in the following amounts (by weight %)

10

	Preferred	More Preferred	Most Preferred
isopropyl alcohol	10-40%	15-25%	20%
acetone	10-40%	15-25%	20%
xylene	35-65%	45-55%	50%
15 paraffin	5-15%	7-12%	10%

20

The composition also preferably comprises one or more, and more preferably all of, the following trace elements: Sr, Bi, Cd, Ba, Ni, Mn, Fe, Na, Zn, Al, Ca, Cu, Pb, Co, K, Cr, Mg, As, Sn, Sb, V, Ti, Be, Si, P, W, and Mo.

25

Yet more preferably, the trace elements are each present in an amount of $\pm 30\%$ of the following figures shown for the respective element: Sr (0.01ppm), Bi (0.05ppm), Cd (0.01ppm), Ba (0.01ppm), Ni (0.07ppm), Mn (0.05ppm), Fe (0.16ppm), Na (4.03ppm), Zn (0.05ppm), Al (0.19ppm), Ca (0.14ppm), Cu (0.02ppm), Pb (0.06ppm), Co (0.01ppm), K (15.59ppm), Cr (0.01ppm), Mg (0.05ppm), As (0.05ppm), Sn (0.34ppm), Sb (0.10ppm), V (0.07ppm), Ti (0.01ppm), Be (0.01ppm), Si (0.39ppm), P (0.17ppm), W (0.14ppm), and Mo (0.01ppm).

30

Without wishing to be bound by theory it is believed that the composition functions because on combustion it produces

35

(i) oxygen which helps oxidise any carbonaceous layer

present on the catalyst surface and which inhibits the function of the catalyst, and/or

(ii) an organic acid (e.g. carboxylic acid) vapour which aids in cleaning the surface of the catalyst.

5 Although the invention is mainly for use with vehicles which run on unleaded fuel, at least some of the compositions work with contamination caused by leaded fuels. For example lead contaminant has been removed from a catalyst in a catalytic converter using a composition of
10 the invention.

According to a second aspect of the invention, there is provided a method of rejuvenating and/or cleaning a catalyst of a vehicle catalytic converter without removal of the catalyst from the vehicle, said method comprising
15 the steps of:

(i) bringing the catalytic converter up to working temperature;

(ii) passing the rejuvenating and/or cleaning composition into an engine of the vehicle whilst running
20 the engine.

In a preferred embodiment of this aspect of the invention, wherein the vehicle has an engine and a fuel line, the method further comprises the steps of:

(i) bringing the engine of the vehicle to working
25 temperature;

(ii) disconnecting the fuel line of the vehicle from the engine;

(iii) connecting the engine to a means for feeding a rejuvenating and/or cleaning composition thereto; and

(iv) feeding the cleaning composition into the engine
30 whilst running the engine to effect cleaning of the catalyst.

In the above-described preferred embodiment, the rejuvenating and/or cleaning is thus carried out in situ,
35 but whilst the engine fuel supply is disconnected from the

engine, the engine being independently run on the composition.

Preferably the cleaning composition is fed into the injection system, through the combustion engine, through
 5 the catalytic converter and out through the exhaust system into the atmosphere.

According to a third aspect of the invention, there is provided a method of rejuvenating and/or cleaning a catalyst of a vehicle catalytic converter without removal
 10 of the catalyst from the vehicle, the vehicle having an engine and a fuel tank, said method comprising the steps of:

(i) introducing the cleaning composition into the fuel tank, said tank already containing a quantity of
 15 fuel; and then

(ii) running the engine of the vehicle to effect cleaning of the catalyst.

Preferably, according to the third aspect of the invention, the amount of composition added is
 20 predetermined by the quantity of fuel contained in the tank, the amount of composition being in the range of 0.5 to 0.75 litres per 30 litres of fuel.

Preferably, according to the second or the third aspect of the invention, the engine is run at a
 25 temperature of from 60 to 90°C, more preferably at or about the vehicle manufacturer's recommended operating temperature.

DESCRIPTION OF PREFERRED EMBODIMENTS

30

The invention will be described, by way of example only, by reference to the following examples and test data.

Example 1

35 An engine of a 1991 Nissan 300 ZX with 72,000 miles

on the clock, and having a catalytic converter which had become poisoned, was run until the engine, and more importantly the exhaust system, reached normal operating temperature (approximately 80°C). The fuel lines feeding the engine were then disconnected and in place of the fuel lines the engine was connected to an injection system purge machine and 1 litre of a rejuvenating and/or cleaning composition containing the following:

10	isopropyl alcohol	20%
	acetone	20%
	xylene	50%
	paraffin	10%

15 and the trace elements as listed previously approximately in the amounts stated, was introduced under pressure into the engine. The machine circulated the composition (which is a liquid at room temperature) under pressure via the fuel injection system. The rejuvenating and/or cleaning composition burned in the engine and the combustion gases and any unburnt fluid travelled over the catalyst of the catalytic converter.

In tests (analysis was by a calibrated four gas analyzer) the composition of example 1 was found to have a significant effect on tail pipe emissions as illustrated in Table 1.

Example 1

<u>Table 1</u>		<u>Before*</u>	<u>After</u>
30	CO%	2.71	0.02
	HC ppm	263	30

Example 2

Example 1 was repeated with a 1992 Vauxhall Astra with 80,000 miles on the clock. The results are set out in Table 2 below which indicates significant effect, on

tail pipe emissions, of the rejuvenation and/or cleaning.

Table 2

		<u>Before*</u>	<u>After</u>
5	CO%	1.45	0.02
	HC ppm	110	8

Example 3

Example 1 was repeated with a 1996 Renault Megane
 10 with 12,000 miles on the clock. The results are set out
 in Table 3 below which indicates significant effect, on
 tail pipe emissions, of the rejuvenation and/or cleaning.

Table 3

		<u>Before*</u>	<u>After</u>
15	CO%	0.00	0.01
	HC ppm	72	27

20 * "Before" means - Before rejuvenating and/or cleaning with the
 composition of the invention.

Example 4

Example 1 was repeated with a Peugeot 605. The
 25 results are set out in Table 4 below which indicates
 significant effect, on tail pipe emissions, of the
 rejuvenation and/or cleaning.

Example 5

30 Example 1 was repeated with a Ford Fiesta. The
 results are set out in Table 5 below which indicates
 significant effect, on tail pipe emissions, of the
 rejuvenation and/or cleaning.

Table 4

	CO	CO ₂	HC	O ₂
Starting value	0.0072%	7.1%	36ppm	10.0%
after treatment	0.002%	13.6%	2ppm	7.6%

5 **Table 5**

	CO	CO ₂	HC	O ₂
Starting value	0.367%	15.3%	116ppm	2.5%
after treatment	0.023%	15.6%	49ppm	2.2%
follow up	0.030%	15.9%	63ppm	2.0%
10 follow up	0.008%	15.3%	23ppm	5.2%
follow up	0.081%		47ppm	

The "follow up" measurements were carried out at approximately 1000 mile intervals.

15 These examples indicate that the catalyst is operating more effectively after treatment, indicating the catalyst has been rejuvenated and/or cleaned.

Example 6

20 Two types of emissions tests were performed on a 1994 model Renault Twingo having a gasoline engine, which had an odometer reading of 129050. The tests were carried out both before and after the following in-tank treatment: 0.5 litre of a rejuvenating and/or cleaning composition

25 identical to that used in Example 1, was added to the vehicle's fuel tank, which fuel tank contained approximately 15 litres of gasoline fuel. The vehicle engine was then actuated in the normal way, by spark ignition, thereby allowing the mixture of fuel and

30 cleaning composition to pass into the engine's injection system and to combust in the cylinder chambers, the unburnt fuel and gases passing through the catalytic converter. The vehicle was driven for a distance of 30 miles at a speed of 50 miles per hour.

Prior to treatment according to the invention, the vehicle was driven on a Clayton chassis dynamometer system DC500, while following the driving schedules of the US Federal test. All exhaust gas sampling was carried out on diluted exhaust gases in a dilution tunnel, which was designed to fulfil the Code of Federal Regulations.¹ The flow of diluted exhaust was 6 m³/min, maintained by a venturi, and the average dilution ratio was approximately 10.5. According to the test, three gaseous transients were sampled. A first "cold start" transient (Y_{ct}) corresponded to emissions produced upon starting the vehicle from a "cold" state, wherein the vehicle engine had not been used in the prior period of 8 to 12 hours. A second, "mid-range" transient (Y_s) corresponded to the emissions expelled at normal working temperature in the drive cycle, while a third transient (Y_{ht}) was sampled upon starting the engine after a 10 minute period during which the engine was at rest.

Measurements of regulated emissions were carried out in accordance with the test procedure described in the literature² using a Horiba 9000 system. The following emissions were measured as follows: carbon monoxide (CO) with a nondispersive infrared analyser (NDIR), total unburned hydrocarbons (HC) with a flame ionization detector (FID), and oxides of nitrogen (NO_x) with a chemiluminescence analyser (CLA).

After completion of the treatment, exhaust emissions were again measured using the dynamometer test already described above. The results obtained before and after treatment, for the Y_s and Y_{ht} transients are shown in Table 6. Cold start (Y_{ct}) measurements were not considered to be of significance, since the temperature in the catalytic converter had not yet reached a sufficient temperature to become effective.

Table 6

	Y _s transient		Y _{ht} transient	
	Before	After	Before	After
CO/ppm	21.5	15.7	222.7	144.4
5 HC/ppm	3.49	3.19	24.12	22.89
NO _x /ppm	0.34	3.19	2.43	3.94

The mediate results in Table 6 show that the CO emissions are reduced by 27-35% in the hot transients, Y_s and Y_{ht}, after treatment with the additive. HC emissions were also reduced significantly.

Static tests were also performed on the vehicle both before and after the treatment. The test was in accordance with the UK MOT procedure, using an Opus 40 Exhaust Gas Analyser, manufactured by Prodox AB and complying with ECE regulations. The engine was run at idling and at 2500 rpm. CO, HC, CO₂ and O₂ values were measured. Before the second test, i.e. post treatment, the vehicle was conditioned with approximately 50 km of driving with the additive in the fuel. All MOT tests were carried out with hot engines. Results from these tests are shown in Table 7.

Table 7

	Idling		at 2500 rpm	
	Before	After	Before	After
CO, %	0.05	0.00	2.9	0.03
HC/ppm	123	38	226	24
CO ₂ , %	13.9	14.6	12.9	15.1
30 O ₂ , %	1.65	0.85	0.21	0.22
Lambda	1.06	1.04	0.91	1.01

From the results in Table 7 it can be seen that the

Renault Twingo after the treatment emitted 70% less HC on idling and 90% less HC at 2500 rpm. The CO emissions were reduced from 0.05% at idling and 2.9% at 2500 rpm to levels below the detection limit.

5

Example 7

In-tank treatment was performed on a diesel-powered 1991 model Volvo 940 which had an odometer reading of 335002 km. Addition of a rejuvenating and/or cleaning composition to the fuel tank, which contained approximately 15 of diesel fuel, was carried out exactly as described in Example 6. The vehicle was driven for a distance of 30 miles at a speed of 50 miles per hour.

The vehicle engine was then actuated in the normal way, by compression ignition, thereby allowing the mixture of fuel and cleaning composition to pass into the engine's injection system and to combust in the cylinder chambers, the unburnt fuel and gases passing through the catalytic converter.

A chassis dynamometer test, exactly as described in Example 6, was carried out before and after treatment. Swedish environmental class 1 (MK1) fuel, from AB Svenska Shell, was used. Particulate emissions were measured using a filter pad which was weighed before and after the test. The results are shown in Table 8.

Table 8

	Y _{ct} transient		Y _s transient		Y _{ht} transient	
	Before	After	Before	After	Before	After
CO/ppm	37.1	31.6	33.3	33.7	26.2	26.3
C ₃ H ₈ /ppm	8.16	6.67	4.77	4.70	6.79	5.36
NO _x /ppm	35.91	38.33	27.92	27.62	36.86	34.87
Particulates / g/km	0.233	0.205	0.117	0.104	0.177	0.138

The results show that the particulate emissions during the transient tests were reduced by 11-22% after treatment with the additive. Other regulated components were not significantly altered. However, CO and HC emissions were reduced by 15% and 18% respectively during the cold start phase (Y_{ct}).

Static opacity tests were also performed on the vehicle both before and after the treatment. The results of these tests are significant as they indicate the amount of particulates emitted from a diesel engine into the air via the exhaust tail pipe. The test system used was a Bosch EAM 3.011 that complied with ECE R24 regulation. This allows measuring capacity at optional points of time and at free acceleration. The light-absorption coefficient k was calculated for every acceleration using the formula

$$K = -1/L \cdot \ln(1-N/100)$$

where N is the opacity and L is the effective length of the measurement probe. The maximum k was noted for every acceleration. The average k over the time from throttle opening to close at the accelerations was calculated as well as the integrated k over the same time. The first of the four free accelerations was omitted. The limit value the MOT test was 3 m^{-1} .

The results of the opacity tests showed a 60% reduction in emissions from 2.51 m^{-1} to 1.04 m^{-1} .

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The above results demonstrate the efficacy of compositions according to the invention as agents for the rejuvenation and/or cleaning of catalysts in catalytic converters. The above-described compositions, when used according to the above-described methods, are shown to be

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effective in the rejuvenation and/or cleaning of catalysts in catalytic converters of both gasoline and diesel-burning vehicles. Further experiments were carried out in which the composition of the agent was varied, and, for the "in-tank" method of Examples 6 and 7, in which the ratio of composition added to the amount of fuel in the tank was varied. These compositions and methods gave similar results to those of the above Examples, though in most cases either a longer treatment time was required, or a less pronounced reduction in emissions resulted. Possible substitutes for the constituents are as follows:

	<u>Original component</u>	<u>Substitute</u>
	xylene	toluene, benzene
15	acetone	Methyl ethyl ketone, cyclohexane, acetone, alcohol
	isopropyl alcohol	ethanol
	kerosene	distillate white spirit

The above Examples are merely illustrative and non-limiting in scope, serving to indicate preferred embodiments of the invention only. It should be understood that variants of the invention are envisaged without departing from the scope of the claimed invention.

References

1. Protection of Environment. Code of Federal Regulations, Parts 81-99 revised as of July 1, 1986. Fed Regist. 1986.
2. Statens naturvårdsverks författningssamling. SNFS 1992:4 MS:45. Kungörelse med föreskrifter om avgasrenig för lätta bilar. A14-Regulation.

I claim:

1. A rejuvenating and/or cleaning composition for a catalyst of a vehicle catalytic converter, comprising at least one hydrocarbon source and at least one oxygen donor.
2. A rejuvenating and/or cleaning composition as claimed in claim 1 wherein said composition generates an organic acid vapour on combustion.
3. A rejuvenating and/or cleaning composition as claimed in claim 2, wherein the organic acid vapour includes a carboxylic acid vapour.
4. A rejuvenating and/or cleaning composition as claimed in claim 1, wherein the oxygen donor or one of the oxygen donors and the hydrocarbon source or one of the hydrocarbon sources are one and the same compound.
5. A rejuvenating and/or cleaning composition as claimed in claim 1, including one or more organic solvents as hydrocarbon source and/or oxygen donor.
6. A rejuvenating and/or cleaning composition as claimed in claim 5, wherein the one or more organic solvents include aliphatic alcohols, ketones, aromatic hydrocarbons and/or aliphatic hydrocarbons.
7. A rejuvenating and/or cleaning composition as claimed in claim 5, wherein the one or more organic solvents include isopropyl alcohol.
8. A rejuvenating and/or cleaning composition as claimed in claim 5, wherein the one or more organic solvents

include acetone.

9. A rejuvenating and/or cleaning composition as claimed
in claim 5, wherein the one or more organic solvents
5 include xylene.

10. A rejuvenating and/or cleaning composition as claimed
in claim 5, wherein the one or more organic solvents
include isopropyl alcohol, acetone and xylene.

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11. A rejuvenating and/or cleaning composition as claimed
in claim 5, wherein the one or more organic solvents
include alkanes, paraffin (kerosene) and/or lamp oil.

15 12. A rejuvenating and/or cleaning composition as claimed
in claim 5, wherein the one or more organic solvents are
selected from isopropyl alcohol, acetone, xylene and
paraffin.

20 13. A rejuvenating and/or cleaning composition as claimed
in any one of the preceding claims comprising isopropyl
alcohol, acetone, xylene and paraffin.

25 14. A rejuvenating and/or cleaning composition as claimed
in claim 13, comprising 10-40 wt% isopropyl alcohol, 10-40
wt% acetone, 35-65 wt% xylene and 5-15 wt% paraffin.

30 15. A rejuvenating and/or cleaning composition as claimed
in claim 13, comprising 15-25 wt% isopropyl alcohol, 15-25
wt% acetone, 45-55 wt% xylene and 7-12 wt% paraffin.

16. A rejuvenating and/or cleaning composition as claimed
in any one of the preceding claims, comprising one or more
trace elements selected from Sr, Bi, Cd, Ba, Ni, Mn, Fe,
35 Na, Zn, Al, Ca, Cu, Pb, Co, K, Cr, Mg, As, Sn, Sb, V, Ti,

Be, Si, P, W, and Mo.

17. A rejuvenating and/or cleaning composition as claimed
in claim 16, wherein those trace elements which are
5 present are each present in an amount of $\pm 30\%$ of the
figures shown for the respective element: Sr (0.01ppm), Bi
(0.05ppm), Cd (0.01ppm), Ba (0.01ppm), Ni (0.07ppm), Mn
(0.05ppm), Fe (0.16ppm), Na (4.03ppm), Zn (0.05ppm), Al
(0.19ppm), Ca (0.14ppm), Cu (0.02ppm), Pb (0.06ppm), Co
10 (0.01ppm), K (15.59ppm) Cr (0.01ppm), Mg (0.05ppm), As
(0.05ppm), Sn (0.34ppm), Sb (0.10ppm), V (0.07ppm), Ti
(0.01ppm), Be (0.01ppm), Si (0.39ppm), P (0.17ppm), W
(0.14ppm), and Mo (0.01ppm).

15 18. The use of a rejuvenating and/or cleaning composition
as defined in claim 1 to rejuvenate and/or clean a
catalyst in a vehicle catalytic converter, in situ, in a
vehicle i.e. without removal of the catalyst from the
vehicle.

20 19. A method of rejuvenating and/or cleaning a catalyst
in a vehicle catalytic converter, in situ, in a vehicle
i.e. without removal of the catalyst from the vehicle,
said method comprising:

25 (i) bringing the catalytic converter up to working
temperature; and then

(ii) passing a rejuvenating and/or cleaning
composition as defined in claim 1 into an engine of the
vehicle whilst running the engine at idle.

30 20. A method as claimed in claim 19, wherein the
rejuvenating and/or cleaning composition is passed into
the vehicle engine under pressure.

35 21. A method as claimed in claim 19, the method further

comprising:

(i) bringing an engine of the vehicle to working temperature;

(ii) disconnecting the vehicle's fuel line from the engine;

(iii) connecting the engine to a means for feeding a rejuvenating and/or cleaning composition thereto; and

(iv) feeding the cleaning composition into the engine whilst the engine is running at a temperature high enough to effect cleaning of the catalyst.

22. A method of rejuvenating and/or cleaning a catalyst of a vehicle catalytic converter without removal of the catalyst from the vehicle, the vehicle having an engine and a fuel tank, said method comprising the steps of:

(i) introducing an amount of rejuvenating and/or cleaning composition into the fuel tank, said tank already containing a quantity of fuel; and then

(ii) running the engine of the vehicle to effect cleaning of the catalyst.

23. A method as claimed in claim 21, wherein the amount of composition added is predetermined by the quantity of fuel contained in the tank, and wherein the amount of composition added is in the range of 0.5 to 0.75 litres per 30 litres of fuel.

24. A method as claimed in claim 21, wherein the vehicle is run at a temperature of between 60 and 90°C.

25. A method as claimed in claim 21, wherein the rejuvenating and/or cleaning composition is as defined in claim 1.

26. A method as claimed in claim 25, wherein the

rejuvenating and/or cleaning composition is combustibile.

27. A method as claimed in claim 25, wherein the
rejuvenating and/or cleaning composition is as defined in
5 claims 1.

28. A method as claimed in claim 25, wherein the vehicle
is run at a temperature of between 60 and 90°C.

10 29. A method as claimed in claim 25, wherein the
rejuvenating and/or cleaning composition is fed into the
injection system, through the engine, through the
catalytic converter and out through the exhaust system
into the atmosphere.

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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In Re Application of:

Hugh Frederick Collins

Group Art Unit: Not Assigned Yet

Examiner: Not Assigned Yet

For: REJUVENATION AND/OR
CLEANING OF CATALYSTS

DECLARATION AND POWER OF ATTORNEY

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name; and

I believe that I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a

☒ Utility Patent ☐ Design Patent

is sought on the invention, whose title appears above, the specification of which:

- ☒ is attached hereto.
- ☐ was filed on _____ as Serial No. _____ .
- ☐ said application having been amended on _____ .

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose to the U.S. Patent and Trademark Office all information known to be material to the patentability of this application in accordance with 37 CFR § 1.56.

I hereby claim foreign priority benefits under 35 U.S.C. § 119(a-d) of any **foreign application(s)** for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of any application on which priority is claimed:

DOCKET NO: THOM-0009

- 2 -

PATENT

Priority Claimed (If X'd)	Country	Serial Number	Date Filed
<input type="checkbox"/>	_____	_____	_____
<input type="checkbox"/>	_____	_____	_____
<input type="checkbox"/>	_____	_____	_____
<input type="checkbox"/>	_____	_____	_____

I hereby claim the benefit under 35 U.S.C. § 120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of 35 U.S.C. § 112, I acknowledge the duty to disclose to the U.S. Patent and Trademark Office all information known to be material to patentability as defined in 37 CFR § 1.56 which became available between the filing date of the prior application and the national or PCT international filing date of this application:

Serial Number	Date Filed	Patented/Pending/Abandoned
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____

I hereby claim the benefit under 35 U.S.C. § 119(e) of any United States provisional application(s) listed below:

Serial Number	Date Filed
_____	_____
_____	_____

I hereby appoint the following persons of the firm of **WOODCOCK WASHBURN KURTZ MACKIEWICZ & NORRIS LLP**, One Liberty Place - 46th Floor, Philadelphia, Pennsylvania 19103 as attorney(s) and/or agent(s) to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith:

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I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Name: Hugh Frederick Collins	
Mailing Address: 12 Beach Lawn Waterloo Liverpool L22 8QA UNITED KINGDOM	Signature Date of Signature: _____
City/State of Actual Residence: Liverpool, UNITED KINGDOM	Citizenship: <u>United Kingdom</u>